RISK SCREEN ON THE USE OF SUBSTITUTES FOR OZONE-DEPLETING SUBSTANCES

PROPOSED SUBSTITUTE: N-PROPYL BROMIDE
END USE: ADHESIVE APPLICATIONS

This risk screen does not contain Clean Air Act (CAA) Confidential Business Information (CBI) and, therefore, can be disclosed to the public.

1. INTRODUCTION

Stratospheric ozone-depleting substances (ODS) are being phased out of production in response to a series of diplomatic and legislative efforts that have taken place over the past few years, including the Montreal Protocol and the Clean Air Act Amendments of 1990 (CAAA). The U.S. Environmental Protection Agency (EPA), as authorized by Section 612 of the CAAA, has developed a program to evaluate the human health and environmental risks posed by alternatives to ODS. The main purpose of EPA's program, called the Significant New Alternatives Policy (SNAP) program, is to identify acceptable and unacceptable substitutes for ODS in specific end-uses.

EPA's decision on the acceptability of a substitute is based largely on the findings of a screening assessment of potential human health and environmental risks posed by the substitute in specific applications. EPA has already screened a large number of substitutes in many end-uses within all of the major ODS-using sectors, including refrigeration and air conditioning; solvent cleaning; foam-blowing; aerosols; fire extinguishing; adhesives, coatings, and inks; and sterilization. The results of these risk screens are presented in a series of background documents that are available in this docket.

The purpose of this report is to supplement EPA's background document (EPA 1994) on the adhesive applications of n-propyl bromide (NPB) or 1-bromopropane, which is used as an alternative to methyl chloroform. NPB is currently being considered under the SNAP program for use in aerosol solvents, as a solvent in electronics, metal, and precision cleaning, and in adhesive applications. The adhesives end use was chosen for this risk screen because it is highly emissive, and has the highest potential for exposure to workers and the general population. In animal studies, NPB has been shown to exhibit toxicity upon inhalation. Section 2 of this report summarizes the results of the risk screen for NPB The remainder of the report is organized similarly to the Background Document. Section 3 presents the toxicity values used for the risk screen. Section 4 presents the results of the atmospheric assessment. Section 5 presents the occupational exposure and risk screening analysis, Section 6 presents the general population exposure and risk screening analysis, and Section 7 discusses potential increases in atmospheric releases of volatile organic compounds (VOCs).

TABLE 1. PROPOSED SUBSTITUTE

Name	Chemical Formula	CAS #
n-Propyl Bromide, or 1-Bromopropane	C_3H_7Br	000106-94-5

2. SUMMARY OF RESULTS

ICF recommends NPB for SNAP approval in adhesive applications. Exposure modeling indicates that use of NPB in adhesive applications may pose a significant risk to human health. Specifically, the 8-hour exposure concentrations of four different scenarios modeled in the occupational exposure screening equal 60.3 ppm, 603 ppm, 253 ppm, and 2,533 ppm, all of which exceed the recommended 8-hour acceptable exposure limit (AEL) of 25 ppm. However, site-specific data show that the installation of spray booths and local ventilation can decrease worker exposure levels to below the AEL. In addition, atmospheric analyses indicate that use of NPB is preferable to the continued use of methyl chloroform. The modeled exposure levels in the general-population exposure screening are all below the reference concentration (RfC).

3. TOXICITY REFERENCE VALUES FOR SUBSTITUTES

To assess potential health risks from exposure to this substitute for ODS in the adhesive sector; EPA developed an AEL for comparison to modeled and actual exposure concentrations. An RfC was developed and used to assess risks to the general population from exposure to ambient air releases and to assess potential risks associated with chronic consumer exposures. The AELs and the RfC are shown in Table 2. Detailed information on the derivation of the AEL and RfC are outlined in Attachments A and B.

TABLE 2. TOXICITY THRESHOLD VALUES

Chemical	AEL	RfC
NPB	25 ppm	1 ppm

4. ATMOSPHERIC MODELING

This section presents EPA's assessment for the potential impact of each substitute on ozone depletion and global warming. NPB has an atmospheric lifetime (ALT) of approximately 19 days and an ozone-depleting potential (ODP) ranging between 0.013 and 0.018 in the U.S., depending on the latitude at which this short-lived halocarbon is emitted. The 100yr GWP of nPB is 0.31 (Atmospheric and Environmental Research, Inc., 1995). This is a relatively low GWP, representing a climate forcing approximately one third that of carbon dioxide, by weight. In contrast, the ALT of methyl chloroform is 4.8 days, the GWP is 140, and the ODP is 0.12. Thus, use of NPB is expected to have a smaller impact on ozone depletion and, potentially, global warming than the continued use of methyl chloroform.

5. OCCUPATIONAL EXPOSURE ANALYSIS

A risk screening exposure assessment was conducted to determine the potential occupational exposures to NPB associated with adhesive use of the compound. The risk screen models a hypothetical adhesive application facility and utilizes a box model to estimate concentrations of NPB that might be present in the air of the facility. The risk screen used a model because site-specific data are not available for most of the facilities currently operating in the U.S.

EPA's box model approach was used to estimate the probable exposures of workers to NPB for four emissions scenarios:

1. Emissions from a facility with average ventilation and average adhesive use (S1);

2. Emissions from a facility with average ventilation and high adhesive use (S2);

3. Emissions from a facility with poor ventilation and average adhesive use (S3);

4. Emissions from a facility with poor ventilation and high adhesive use (S4).

Detailed information on the assumptions used to construct these scenarios, as well as the methodology used to generate exposure estimates is presented in Attachment C. The results of the analysis are outlined in Table 3. The exposure concentration from each scenario exceeds the recommended 8-hour AEL of 25 ppm.

TABLE 3. EIGHT-HOUR EXPOSURE CONCENTRATION (ppm) TO NPB

	Average adhesive use	**High adhesive use**
Average ventilation	60.3 (S1)	603 (S2)
Poor ventilation	253 (S3)	2,533 (S4)

Monitoring data were obtained from three facilities that use NPB as a spray adhesive. These facilities are the STN Cushion Company in Thomasville, NC; Custom Products, Inc., in Morrisville, NC; and Marx Industries in Sawmills, NC. NPB exposure was measured by personal monitoring devices placed in the breathing zone, and area air sampling was conducted at various location and work stations where adhesives are used. The monitoring values range from 5.4 ppm to 254 ppm; the wide range is a result of variations in both the amount of adhesive applied and the ventilation conditions. These monitoring data were compared to the modeled concentrations for the four hypothetical situations discussed previously.

STN Cushion Company and Marx Industries, Inc., both of which had insufficient ventilation at their facilities, had exposure concentrations comparable with the estimated values of S3. Custom Products, Inc., had exposure data that were comparable to the estimated value for S1. The National Institute for Occupational Safety and Health (NIOSH) performed a heath hazard evaluation at Custom Products, Inc., in November 1998. During the evaluation, workers' exposure was monitored during spray application of NPB. NIOSH investigators recommended the installation of spray booths and local ventilation. A follow-up assessment was performed in November 2000 to document the change in exposure concentrations associated with the new control devices. Table 4 provides the concentrations obtained prior to, and after the installation of control measures (Reh 2000).

TABLE 4. COMPARISON OF EIGHT-HOUR EXPOSURE CONCENTRATIONS; 1998 VERSUS 2000 SAMPLING DATA.

Sample Set	November 1998 Mean NPB Exposures (ppm)	November 2000 Mean NPB Exposures (ppm)
All Exposure Data	168.9	19.0
Sprayers	193.0	21.7
Assemblers	154.7	19.5
Assembly Department Data	169.8	18.8
Covers Department Data	197.0	29.2
Saw Department Data	117.1	1.8
Sew Department Data	128.1	1.4

The mean 8-hour concentrations from the November 2000 sampling indicate a significant decrease from those values obtained in 1998. The mean exposures for assembly data, saw data, and sew data were all below the AEL. Workers in the Covers Department had a mean NPB exposure level of 29.2 ppm indicating that additional measures are necessary in this department to meet the AEL. Since all covers workers are sprayers, increased controls would have to be added as well as better ventilation in order to ensure that exposure levels remain at acceptable levels. It is likely that the appropriate levels could be maintained by reducing the number of hours a worker performs spraying activities and/or implementing readily available and inexpensive control technologies that are standard industry good-housekeeping measures. Facilities should also post signs that outline hygiene and handling proceedures, and train their employees on the proper handling of NPB and compounds containing NPB.

6. GENERAL POPULATION EXPOSURE ANALYSIS

A risk screening exposure assessment was performed to estimate a reasonable worst-case exposure concentration for the general population resulting from occupational use of NPB-containing spray adhesives. This assessment also models a hypothetical facility similar to those currently in operation. Two emission scenarios were considered in this analysis, both of which used NPB to bond furniture and mattresses:

1. Emissions released from a stand-alone average-size adhesive application facility (S5);

2. Emissions released from an urban row-house-type warehouse (S6).

Within S5, three types of releases were considered:

1. Emission released as a fugitive (non-vented) area source released upwards through the roof of the facility;

2. Emissions released as a single point source (vented) upwards on the roof of the facility;

3. Emissions released as a fugitive (non-vented) source horizontally through cracks, leaks, window ventilation and shaft ventilation (natural ventilation).

Within S6, four types of releases were considered:

1. Emissions released as a fugitive (non-vented) area source released upwards through the roof of the house;

2. Emissions released as a single point source (vented) upwards on the roof of the house;

3. Emissions released as a fugitive (non-vented) source horizontally through cracks, leaks, window ventilation and shaft ventilation (natural ventilation);

4. Emissions released as a fugitive source horizontally using commercially available fans capable of accomplishing at least 1.3 air exchanges per hour.

Detailed information regarding the assumptions used to construct the scenarios and the methodology used to generate exposure estimates are presented in Attachment D. EPA's SCREEN3 air dispersion model was used to assess dispersion of emissions to estimate the highest 1-hour concentration from S5 or S6.

The vented emission concentrations from S1 facilities were lower than the non-vented emissions and are well below the RfC. None of the S6 scenarios modeled had an exposure concentration that exceeded the RfC of 1ppm; however, the non-vented horizontal releases (with fans) resulted in higher values than the other S6 cases.

7. VOLATILE ORGANIC COMPOUND ANALYSIS

With respect to NPB, the analysis presented in the Background Document has shown that potential emissions of VOCs from all substitutes for all end-uses in the adhesive applications sector are likely to be insignificant relative to VOCs from all other sources (i.e., both anthropogenic and biogenic).

8. REFERENCES

Atmospheric and Environmental Research, Inc.1995. Estimates of the Atmospheric Lifetime, Global Warming Potential and Ozone Depletion Potential of n-Propyl bromide.

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Reh, C., NIOSH, to S. Cothran, STN Cushion Company, March 7, 2001. Letter containing data and conclusions for a November 14, 2000 NPB exposure assessment conducted at STN Cushion Company, located in Thomasville, NC.

U.S. EPA. 1994. Risk Screen on the Use of Substitutes for Class I Ozone-Depleting Substances: Adhesives, Coatings, and Inks.